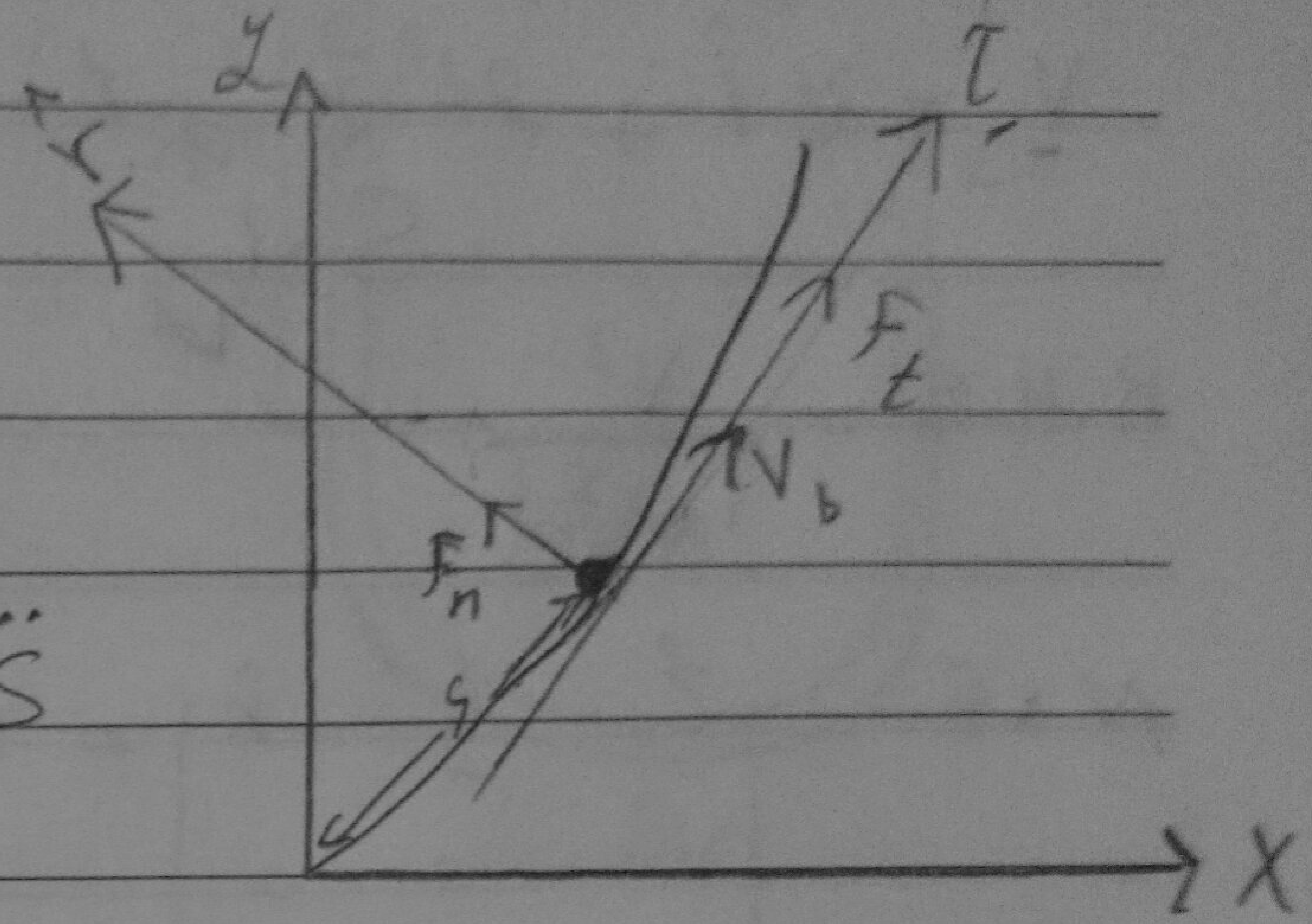
Date: (S.03) Subject:

الاحداثيات الطبيعية

$\hat{\tau}$ متجه الوحدة المماسي

$\hat{n}$ " " العمودي على المماسي



$\underline{V} = V\,\underline{\hat{\tau}}$, $V = \frac{ds}{dt} = \dot{S}$

$\underline{F} = F_t\,\underline{\hat{\tau}} + F_n\,\underline{\hat{n}}$, $F_t = \frac{dv}{dt} = \ddot{S}$

$F_n = \frac{V^2}{\rho}$ ← نصف قطر التقوس

F_n تتغلب على قوة الطرد المركزية

$F = \sqrt{F_n^2 + F_t^2}$

$$\rho = \frac{V^3}{|\underline{V} \times \underline{F}|}$$

$\boxed{9}$ prove that $\rho = \frac{V^3}{|\underline{V} \times \underline{f}|}$

أوجد ρ

$\underline{V} = 3t\,\hat{i} + 2t^2\,\hat{j}$, $t = 1$

Sol

$$R.H.S = \frac{V^3}{|V \times f|}$$

$$V \times f = \begin{vmatrix} \hat{\underline{t}} & \hat{\underline{n}} & \hat{k} \\ \bar{V} & 0 & 0 \\ f_t & f_n & 0 \end{vmatrix} = 0\,\hat{\underline{t}} - \hat{\underline{n}}\,(0) + \hat{k}\,(V f_n) = (V f_n)\,\hat{k}$$

$$|V \times f| = V f_n$$

$$\frac{V^3}{|V \times f|} = \frac{V^{\cancel{3}\,2}}{\cancel{V} f_n} = \frac{V^2}{f_n} = \rho \;\#$$

at $t = 1$

$\underline{V} = 3\hat{i} + 2\hat{j} \Longrightarrow V = \sqrt{13}$

$\underline{\hat{f}} = 3\hat{i} + 4t\,\hat{j}$

$\underline{f} = 3i + 4j \Longrightarrow f = 5$

$$V \times F = \begin{vmatrix} \hat{i} & \hat{j} & k \\ 3 & 2 & 0 \\ 3 & 4 & 0 \end{vmatrix} = 6\,\underline{k}$$

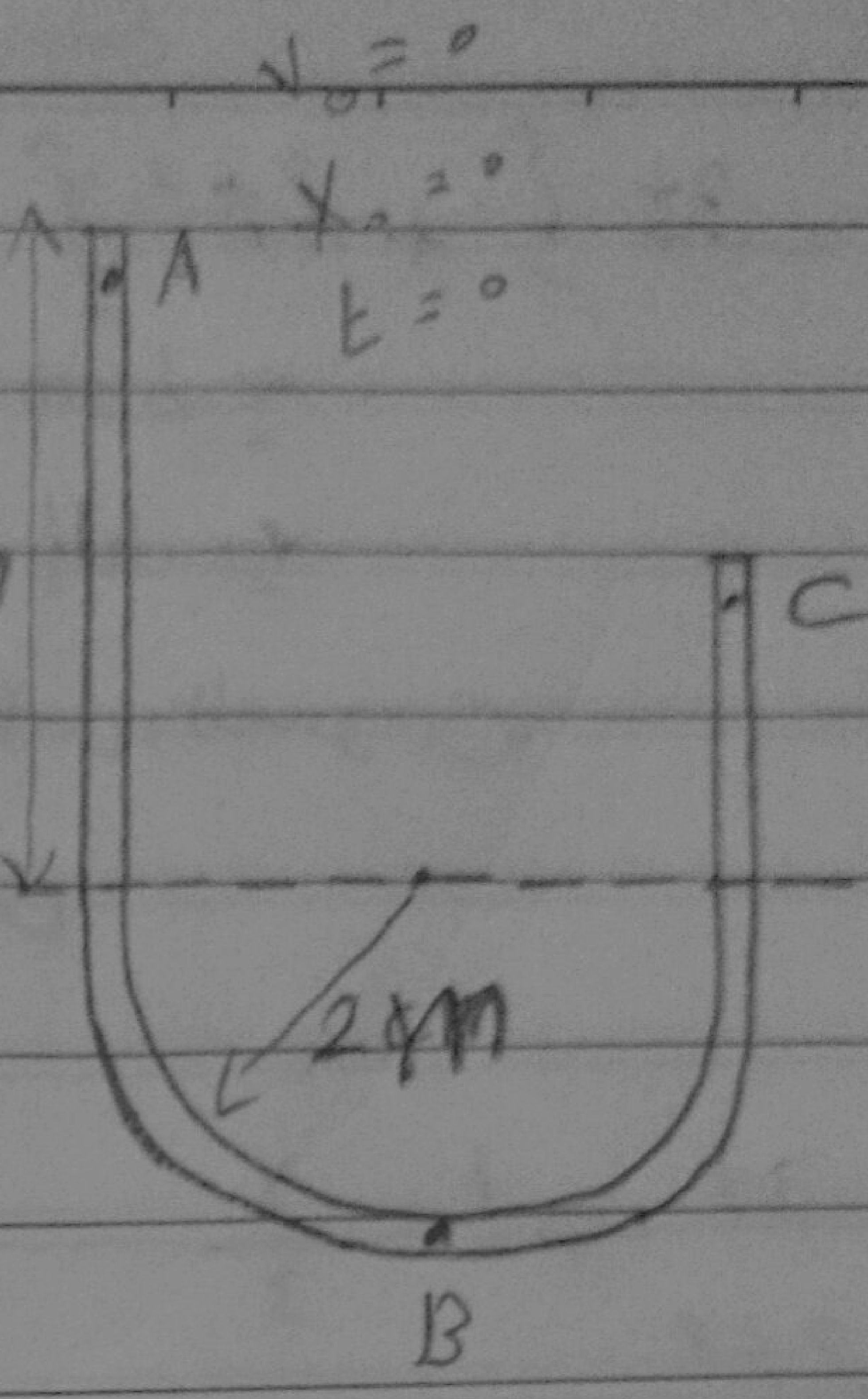
$$\rho = \frac{V^3}{|V \times F|} = \frac{(\sqrt{13})^3}{6}$$

$\boxed{10}$

$\underline{V} = V\hat{Z}$

$\underline{\bar{F}} = F_t \underline{\hat{Z}} + F_n \underline{\hat{n}}$

$F_t = .2\,t$



$X = 3 + \frac{\cancel{2}\pi \cancel{2}}{\cancel{4}}$

$X = 3 + \pi$

$f_n = \frac{V^2}{\rho} = \frac{V^2}{2}$

$F_t = 0.2t$

$\frac{dV}{dt} = .2t$

$\int dV = \int .2t \, dt$

$V = .1t^2 + C \Longrightarrow C = 0$

$\boxed{V = 0.1t^2}$

$\int dX = \int .1\, t^2 \, dt$

$X = \frac{.1}{3} t^3 + C \Rightarrow C = 0$

$\boxed{X = \frac{1}{30} t^3}$

$\frac{t^3}{30} = 3 + \pi \Longrightarrow t = \checkmark$

$V = .1t^2 = \checkmark$ $\quad F_t = .2t = \checkmark$

$F_n = \frac{V^2}{2} = \checkmark$

$\underline{r} = 3t\,\hat{i} + 2t^2\,\hat{j}$

[1] أوجد معادلة المسار ، [2] أوجد مركبات السرعة والعجلة بالقطبية

[3] " " " " و " بالطبيعية

$t = 1$ sec

[4] أوجد متجهي الوحدة المماس والعمودي

[5] نصف قطر التقوس

Sol ↙

[1] $x = 3t \Rightarrow t = \frac{x}{3}$

$y = 2t^2$

$y = 2\left(\frac{x}{3}\right)^3$ #

$\underline{r} = 3t\,\hat{i} + 2t^2\,\hat{J} \Rightarrow \underline{r} = 3\hat{i} + 2\hat{J} \Rightarrow r = \sqrt{13}$

$\underline{V} = 3\hat{i} + 4t\,\hat{J} \Rightarrow \underline{V} = 3\hat{i} + 4\hat{J} \Rightarrow V = 5$

$\underline{f} = 4\hat{J} \Rightarrow f = 4$

$\underline{r} = r\,\hat{\underline{r}}$

$\hat{\underline{r}} = \frac{\underline{r}}{r} = \frac{3\hat{i} + 2\hat{J}}{\sqrt{13}} = \frac{3}{\sqrt{13}}\hat{i} + \frac{2}{\sqrt{13}}\hat{j}$

$\underline{V} = V_r\,\hat{\underline{r}} + V_\theta\,\hat{\underline{\theta}} \qquad .\hat{\underline{r}}$

$\underline{V}.\hat{\underline{r}} = V_r\,\underbrace{\hat{\underline{r}}.\hat{\underline{r}}}_{1} + V_\theta\,\underbrace{(\hat{\underline{\theta}}.\hat{\underline{r}})}_{0}$

$V_r = \underline{V}.\hat{\underline{r}} = (3\hat{i} + 2\hat{J}).\left(\frac{3}{\sqrt{13}}\hat{i} + \frac{2}{\sqrt{13}}\hat{J}\right) = \frac{9}{\sqrt{13}} + \frac{8}{\sqrt{13}} = \frac{17}{\sqrt{13}}$

$V = \sqrt{V_r^2 + V_\theta^2}$

$5 = \sqrt{\left(\frac{17}{\sqrt{13}}\right)^2 + V_\theta^2}$

$V_\theta = \sqrt{\ }$

$$\underline{V} = V\,\underline{\hat{\tau}}$$

$$= 5\,\underline{\hat{\tau}}$$

$$\underline{\hat{\tau}} = \frac{\underline{V}}{V} = \frac{3}{5}\hat{i} + \frac{4}{5}\hat{j}$$

$$\underline{F} = F_t\,\underline{\hat{\tau}} + F_n\,\underline{\hat{n}} \qquad \cdot\,\hat{\tau}$$

$$F_t = \underline{F}\cdot\underline{\hat{\tau}} = \checkmark$$

$$F = \sqrt{F_t^2 + F_n^2} \Longrightarrow F_n = \checkmark \qquad F_n = \frac{V^2}{\rho}$$

$$\underline{F} = F_t\,\underline{\hat{\tau}} + F_n\,\underline{\hat{n}} \Longrightarrow \underline{\hat{n}} = \checkmark$$